

DOCUMENT RESUME

ED 269 175

RC 015 658

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TITLE Electronic Networking in the Rural Special Education Environment.
PUB DATE Oct 85
NOTE 63p.; Paper presented at the Annual National Rural Teacher Education Conference (1st, Bellingham, WA, October 1985).
PUB TYPE Information Analyses (070) -- Speeches/Conference Papers (150)
EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Access to Education; *Access to Information; Computer Assisted Instruction; Computer Managed Instruction; Elementary Secondary Education; Foreign Countries; *Information Networks; *Microcomputers; *Rural Education; *Special Education; Technology Transfer; *Telecommunications; *Telephone Communications Systems
IDENTIFIERS Canada

ABSTRACT

Rural-based special educators are examining the use of microcomputer technology to provide service to special education students. Recent literature is replete with examples of situations where microcomputer telecommunications have altered the isolation of special need populations in areas of communication, computer access, environmental control, and mobility. Exemplary networks include SpecialNet, INTELSAT, SHARE, the Kentucky Project, DEAFNET, CONFER, and MERIT. Telephone-based data-communication systems, utilizing standard telephone utilities, can tap services of global telephone networks and place isolated users in instant liaison with selected partners. Such systems require microcomputers and modems, optional printers, plus appropriate software. Almost 350 data repositories are available for accessing by microcomputer and modem, including DIALOG, BRS, and SpecialNet which offers electronic mail, bulletin board, and data collection/information management services targeted specifically to those involved in special education. An example of a small-scale, service-oriented electronic network is Prairie Post, a bulletin board developed by the Rural Special Education Outreach Project, University of Lethbridge (Alberta, Canada). Although microcomputers have already demonstrated their ability to support improved initial learning and transfer of knowledge organized and delivered by competent teachers--and are already present in many schools--appropriate utilization and equitable distribution to handicapped students will require vehement advocacy by special educators. (NEC)

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QC 015658



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Presented to the

NATIONAL RURAL DEVELOPMENT INSTITUTE
FIRST ANNUAL (1985) CONFERENCE
NATIONAL RURAL TEACHER EDUCATION CONFERENCE
OCTOBER, 1985

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KEYS TO THE WORLD - A BRIEF EXAMINATION OF MICROCOMPUTER TECHNOLOGY FOR TELECOMMUNICATIONS

For the first time, the handicapped will have equal access to information. This will give them an equality of opportunity never before available. The blind will never be restricted to someone else's choice of literature, the hearing impaired will be able to communicate with anyone over great distances, and the physically handicapped will have access to any information they choose from their wheelchair. Telecommunications via the microcomputer will, for the first time, give the handicapped equal opportunity in society. (Hagen, 1984, p. 9)

PROLOGUE - A UTOPIAN VIEW

1.0 Rural Special Education and Technology

Rural-based special educators universally share frustration and disenchantment as they wrestle with urban-oriented service models that assume large population bases and homogeneous target service populations. The typical rural human service reality is a complex one, as variables such as small size, geographic isolation, and minimal financial-technical-professional supports challenge even the most competent administrators and advocates. The impact and effectiveness of many special education undertakings in rural settings demand an inordinate amount of human energy and financial support, and often

therefore significantly increase the interpersonal tensions of those involved.

As Helge (1980) reported, the post 1975 environment in the United States marked a major turning point in educational service provision for rural-based special needs populations, with major improvements in the quantitative impact of all services provided. However, qualitative service delivery in rural areas will forever challenge the innovativeness of educational leaders because all resources will be taxed maximally. The rural special education environment provides fertile soil in which to implant cost-effective and time/energy enhancing technological aids.

To this observer, isolation in both its physical, interpersonal and intrapersonal dimensions, is the primary obstacle to overcome if the rural handicapped are to achieve meaningful standards of normalization and integration.

To illustrate, using 1984 as the base year and the Northwest Territories of Canada as the venue, 49,000+ inhabitants were spread over 3 1/3 million square kilometers (1,304,900 square miles). Visualize approximately one inhabitant for every 70 square

kilometers of relatively harsh terrain. Visualize further an ethnically diverse population in which handicapped individuals are disproportionately affected by climatically-induced factors (eg. chronic otitis media) and socially-induced factors (eg. fetal alcohol syndrome). It is apparent with today's value system that traditional service models based on institutionalization and consequent severance from family/community ties are inappropriate. Such a population requires ingenious and bold innovation if the ideal of individualized service is to be attained in the home community.

Rural-based handicapped populations, most certainly those in Canada and probably universally, could benefit greatly from the application of technology, and especially telecommunications technology, which could enhance personal and interpersonal competence.

2.0 Introduction

This article will focus on the general application of microcomputer technology enhanced by data communication processes.

The effectiveness of computer-based instruction

(CBI), computer-assisted instruction (CAI), and computer-managed instruction (CMI) for special needs students has attracted much attention in the past decade. These three areas of service, CBI-CAI-CMI, are already well documented as powerful teaching and support agents enhancing the learning processes of special needs children.

It is widely accepted that the primary factor responsible in restricting the full utility of established technological achievements for special needs populations are the limits of our imaginations and creativity. Real limitations of monetary cost can be overcome when human advocacy prevails, as was dramatically illustrated in the Live Aid concert. Only advocacy by many will ensure the equitable distribution of the requisite technology to these children.

It is a basic assumption of this paper that advanced computer technology, when interfaced with advanced conceptions of how individuals learn, will provide a fresh insight into the "handicapped" learner. Ideally such an individual might come to be seen as a remarkable learner. As a minimum we can realistically expect such an individual to demonstrate enhanced competency and self-esteem as technology facilitates the growth of independence.

Perhaps no better testimony can be found to illustrate this concept than these words offered by individuals involved in a direct advocacy role for the physically handicapped:

The benefits of telecommunications to physically handicapped students are enormous. As stated previously, this is one and maybe the only sphere in their lives where they're on the equal basis with able-bodied persons.

At Mesa High, physically handicapped students using telecommunications are looked up to as "experts" by other able-bodied students. It has greatly enhanced their mainstreaming and social opportunities. Roles are reversed when the able-bodied student is dependent on the disabled student for assistance within this area. Some activities that able-bodied persons take for granted such as banking or shopping, are either very difficult or impossible for severely handicapped people to perform. With the advent of telecommunications, this has changed. (Cunningham & Gose, 1985, p.4).

The recent avalanche of publications acts as one index of the firm foothold that microcomputer utilization has gained in the field of special education. The influential Closing the Gap agency in Minnesota delivers its primary publications, and conducts international conferences, directed toward the use of microcomputers in special education. Journals such as Byte, Exceptional Children, and Special Services in the Schools have published special issues on the topic. Focused journals, such as the Journal of Special Education Technology, are now dedicated to the

issue. Primary references are now appearing, of which Handbook of Microcomputers in Special Education (Behrmann, 1984), Microcomputer Resource Book for Special Education (Hagen, 1984), and Microcomputers in Special Education (Taber, 1983) serve as exemplars.

In each of the above microcomputer telecommunications has been addressed as a significant breakthrough in altering the isolation experienced by special needs populations.

To illustrate, the physically handicapped individual has specific needs in the areas of communication, computer access, environmental control and mobility, and of these four need areas

communication is by far the most important ... the level of achievement reached is closely tied to the ability to communicate. The more effective a person's communication skill, the further that person may be expected to go in life.

The transition to an information based society is a boon to people with physical handicaps ... A physical handicap doesn't have to affect a person's ability to access, process, and communicate information. Today, no person should be provided with a communication system, environmental control or powered wheelchair without consideration for access to computers. (Romich & Vagnini, 1984, p. 71-72).

Cunningham and Gose (1984, p. 1) clearly identify how technology has extended a powerful process to the physically handicapped in the following quotation:

Non-verbal physically handicapped students can communicate via modem as well as you and I. Telecommunications and all its benefits are just as applicable to the physically handicapped user as to the able-bodied user. More importantly, telecommunications gives the physically handicapped user opportunities to interact with the environment that did not exist before. In spite of technical jargon, getting on-line is easy and enjoyable when you use software equipment or addition of peripherals such as switches or electronic communication boards, physically handicapped persons can be just as adept at telecommunications as able-bodied persons.

Communication is one of man's most significant processes, primarily because it enhances the capacity and extension of intelligent and social interchange. Inefficient/ineffective or non-existent communication skills isolates and restricts the power of intellect. Further, the interpersonal exchange of intrapersonal ——— thought can both enhance social affiliation and catalyze the learning process by providing a medium for the embellishment of concepts.

2.1 Telecommunications - The (Intra)Personal Computer Becomes Interpersonal

The decade of the 1980's has seen the emergence of data processing, information management, and telecommunication (via telephone, radio, television) as dependant entities. Computer-based information manipulation and telecommunications have united to form a powerful unity called "telecommunications"

(literally communication over great distances.) The technology responsible for this convergence is called networking, which is the computer-controlled system for managing information across locations.

Taber, (1984) identified five significant freedoms which would accrue to individuals with special needs and their advocates, through the effective use of technology. These include the efficient/effective use of time, the enhancement of learning processes and outcomes, greater environmental independence, and meaningful involvement in gainful employment. Such primary achievements can be expected from the judicious application of technology on behalf of those with special needs, and each relate directly to the enhancement of communication - Taber's fifth freedom.

The most important potential freedom achieved through technological intervention, to this author's bias at least, is the freedom to communicate. Effective communication processes provide a vehicle for information sharing but also enhance self-esteem, given the importance of communication in our society.

Thus microcomputers enhanced by peripherals such as speech synthesizers, enable the handicapped to share thought even if limited to a single physical space.

Recent developments in peripheral technology, such as Autospeak (a text-to-speech synthesizer which allows a speech impaired person to pre-enter as many as thirty-two sentences and direct these at will to a speech synthesizer) and the Cacti Communication Program (which enables the printing of words/phrases on the screen or printer with a minimum number of key presses) serve as examples of liberating technology. These facilitative devices, when linked together through a telecommunications network, greatly enhance communication freedom because the boundaries of space and time can be overcome.

Telecommunication processes managed by network systems offer a new but powerful area of special education service, and could revolutionize present concepts of schooling and education for all children. For example, electronic bulletin boards presently give many teachers and parents the ability to directly and inexpensively access and retrieve qualitative curriculum strategies validated elsewhere with special needs children similar to their own. Information utilities such as SpecialNet have arisen to allow subscribers to access large specialized libraries of special education information. These utilities add the

luxury of electronic mail as a service.

Literally, telecommunications processes have extended our communication neighborhood from relative "back-fence chatter" to global interaction in less than a decade. The lives of individuals affected by handicapping conditions living in isolated communities can be radically improved through vigorous individual, collective, and corporate advocacy in bringing these developments to their service.

As one example, INTELSAT, (the 109 member-country cooperative organization that owns and operates a global system for international telecommunications announced in 1984 a major project which has outstanding implications for eventual benefit to the handicapped. Project SHARE, jointly operated by the International Telecommunications Satellite organization (INTELSAT) and the International Institute of Communications, will experiment through 1985 with a wide range of telecommunications technologies to serve the health and education fields.

SHARE's primary purpose is to investigate improved service to rural and isolated parts of the world. Included will be experiments in a variety of audio/video communication modalities, as well as

microcomputer-to-central computer interactive data links for sharing information of critical medical and educational value. Since simultaneous two-way voice transmission will also will be carried over the same channel, an opportunity will be developed for educational visionaries to establish a new format for electronic communications serving the school without walls.

The visionary objective of a school without walls is now possible, enabled by the application of computer-generated/telephone-delivered instruction from a knowledgeable source to populations previously isolated by age, severity of handicap, and physical distance. The Kentucky Project (Tawney, Aeschleman, Deuton & Donaldson, 1979), while employing technological equipment viewed as obsolete in today's world, established a prototype delivery system to reach severely developmentally delayed and multiply-handicapped pre-schoolers in their homes.

These low-incidence heterogeneously handicapped populations thus received quality educational service delivery through the medium of technology. What are the normalization and integration implications of technology for all children?

2.2 Limitations

This article will attempt to provide a brief exposure to several of the present applications of telecommunication processes and a simplified explanation of operational components. It will conclude with a focused description of a small-scale electronic network and bulletin-board system initially developed by the Rural Special Education Outreach Project (RSEOP) of the University of Lethbridge (Alberta, Canada), which has now been expanded to a larger service community.

Our discussion will be limited to a discussion of telephone-based data-communication systems which differ functionally from LAN's ("local area networks"). LAN's are generally "hard-wired" and limited to single building or campus-based environments. They provide powerful communications features for computers in relatively close proximity.

Telephone-based systems, while normally limited to two-party interchanges, can be enhanced with numerous service configurations. Because they utilize standard telephone utilities, they can tap the services of the global telephone network and place the isolated user in

instant liaison with selected partners.

3.0 A Brief Overview of Microcomputer
Telecommunication Processes Applied to Special
Needs Populations

In the network environment rewards come by
empowering others, not climbing over them.
- Naisbith/Megatrends

Traditional print mediums have served some 5,000 years to bring knowledge to an information-hungry world. Contemporary examples range from the colloquial/practical knowledge extended through newsprint to the scientific journals of a myriad of research communities: all bring information to specialized target populations.

Today, futurists discuss the emergence of the global village in which electronic highways usurp the information dissemination role of traditional communication systems. Communication media thought visionary in mid-century are now a pragmatic reality, facilitated by applications such as microwave transmission, fibre optic relays, videotex/teletext, satellite broadcasting and cable exchange. Information utilities and computer subscription services are now commonplace as a result, although at this point, the business and technical communities dominate (if not monopolize) these communications services.

Although PROJECT SHARE (described earlier) shows the potential impact of major corporate investment and advocacy, today even relatively unsophisticated computer users are able to participate in the global village through the use of "modems" and other peripheral devices. Communications hardware/software packages incrementally enhance the powerful stand-alone capacity of a microcomputer by enabling it to share and to interact.

That technological advancements will increase exponentially is obvious; maximum "user-friendliness" and utility will convert present exotic applications to plebian usage. Photo-digitizers, voice recognition units, and speech synthesizers will be integrated and improved to the point that standard keyboards may well become obsolete and thereby remove one of the larger obstacles to mass computer interaction. As a result, immediate benefits have already been achieved for physically and sensorily-handicapped individuals. In the near future all special needs populations are projected of benefit from this technological catalyst promoting their independence. To achieve this, however, the educational social service, and business/technical communities must be motivated to advocate concurrently on their behalf.

Unfortunately, the scientific and business communities embrace technological innovation with a passion that the social service and educational communities in the public domain view both with alarm and envy. One exception is noteworthy at this point: that sector of public education known as "special education", perhaps because of the pressing and massive needs of its human charges, appears to have come to respect technology as the most powerful normalizing and integration agent yet encountered.

Earlier it was said that CBI-CAI-CMI applications with special needs populations are powerful normalizing agents if carefully utilized and monitored. Adding the power of selected peripheral devices which enable, enhance, and empower the process of communication can allow technology to be a liberating tool.

Behrmann addresses the related question of equitable access and information-sharing made possible by computer networking. He defines networking as "a computer-controlled system for managing information across locations" (Behrmann, 1984, p. 253). Networking also permits the sharing of peripheral devices and software, leading to greater participation by all in applications such as teleconferencing and electronic publication. Behrmann (1984) comments:

The concept of networking is a major step toward breaking down barriers to the education of handicapped children. Networking fosters professional development, professional communication, accessibility and integration of information and human resources, and direct individualized interactive student instruction regardless of possible geographic or physical limitations. Finally, it offers the opportunity to extend school services to the home environment and facilitate parent-school communication and interaction (p. 253).

An established example of an effective electronic network is DEAFNET. It has been generated and maintained by GTE Laboratories, and provides those with auditory difficulties an international access to interpersonal communications via electronic mail and bulletin board information-sharing.

At a later point in this paper, reference will be made to the first exciting educational application for the DEAFNET System, developed by New York University.

To review at this point: the acquisition of hardware (modems, acoustic couplers) and appropriate communications software enable the "intrapersonal" computer to become "interpersonal". Acquiring and disseminating information becomes a universal opportunity, provided that advocates for the handicapped demand equity in the distribution and utilization of the requisite technology.

Thus, "interpersonal" microcomputers, accessing and enhancing information banks and communicating (electronically but not necessarily impersonally), should generate excitement in the special education community if not elsewhere in public education.

A new term, "telematics" (Brennan & Sniggs, 1984) has recently emerged to describe the hardware, software, network and content components involved in this exciting process. It appears that telecommunications and networking have gained a slot for future academic investigation, and that new concepts such as image grammar, mediatics, and telematics will become colloquial expressions in the near future.

4.0 Keys to the World - Acquiring Hardware/Software Components to Initiate the Process

4.1 Introduction

Assuming the reader is motivated to apply the benefits of computer-based communications directly or as an advocate for special needs individuals, then a small number of hardware items (specifically, a microcomputer and modem; ideally a printer as well) and appropriate "terminal" or "communications" software must be acquired. The function of each will be

reviewed in this section.

The microcomputer is simply an information manager. Its impressive functional ability can be extended dramatically. Relatively "dumb" stand-alone units become "smart" interactive terminals by the addition of appropriate terminal software. The essential supplementary requirements which require a brief explanation include communications software (incorporating word processing software), modems, and serial interface cards.

4.2 Hardware/Software Units

4.2.1 Communications Software

The communications software, as the "information choreographer," is simply the set of computer instructions (i.e. program) which determines how the microcomputer should process the information it receives or transmits. It is the crucial component to the effective use of a microcomputer as a telecommunications device.

Regardless of your specific microcomputer model, barring memory requirements, your software choice will

directly affect the flexibility and ease of communication. Just as different telephone formats (eg. regular, memory-phone, cordless, radio-telephone or PBX exchange) provide essentially the same audio communications, each type is designed to meet specific requirements.

This is true for computer based communications software as well. Therefore, one should insure that the software package selected has the features desired. It is often the case that selection of a software package will determine the type of hardware configuration required to implement those features.

Recently, the journal, Creative Computing (Vol. 11, #2, February, 1985) reviewed seventeen commonly employed communications packages. Of those reviewed, DataCapture was rated as the easiest for the novice to employ, Softerm as the most desirable for those wishing to interact with mainframe computers, and ASCI111 Express as to the most sophisticated. It would appear to be a judicious practice to investigate this area thoroughly.

Basic software functions include the ability to transfer information to and from a storage medium such

as a diskette. This important feature enables the user to tap into information sources and capture the resulting communications onto a diskette for future reference.

The most common information transfer involves the retrieval of text files which may be easily accessed and modified using one of the many text word processors such as Applewriter or Screenwriter. The reverse is also possible, as messages may be prepared in advance using a word processor and then transferred to another computer using the communications software.

The capture-to-disk and send-from-disk feature allows information to be transferred at the maximum rate that the computer can transfer (defined as the baud-rate). Most modems (described below) transfer data at either 300 or 1200 baud, approximately equivalent to 30 and 120 characters per second respectively. The final consequence of this feature is the reduction in telephone connect time and associated charges, as the message is formatted off-line at the users convenient speed and style.

Another feature which assists in the efficiency of communications is the ability to create macro commands. A macro is a command or string of commands which may be

issued with a single or minimal number of keystrokes. For example, using a particular software package, the command "Check Exchange; Scan Since February 20; read from Counterpoint" can be given using essentially one keystroke. Automatic dialing is also thus enabled as the software can take control of the computer when the communications disk is booted and execute a macro list you have created, including the appropriate telephone number and logon procedures (computer identification, names and passwords). This is an excellent feature where the complexity of the system inhibits a user's access, or where a specific disability reduces keyboard efficiency.

Further, "front end search software" can be utilized to permit convenient off-line search entries, and permit automatic searching, downloading, and logging exits. Software examples which accomplish this include In-Search (Menlo Corporation) and Search Helper (Information Access Company).

Finally, "gateway" systems such as Easynet have major potential use for the handicapped because they provide the user menu-driven systems to access data bases such as Dialog and SpecialNet with minimum computer skill proficiency.

4.2.2 The Modem

An appropriate modem must also be selected. The word, "Modem" is an acronym condensed from two words which describe its function: mo (dulator) and dem (odulator). The modem is the electronic circuitry which acts as a translator between the computer and the telephone network, obvious when the reader recalls that the telephone network was designed to transmit audibly-recognizable analogy sounds while the computer utilizes a code of digital electrical pulses. The modem simply translates the computer's codes into audible tones which can be sent over the telephone (i.,e. changes ditital signals into audio tones). A receiving modem retranslates these tones into computer code now again comprehensible to the receiving computer.

The modem is data communication hardware, while the computer is data terminal hardware. Modem speed, measured in bits/second, is commonly referred to as the baud rate. (This expression is somewhat incorrect as a result of technological advances, but the term has persisted). While 300 to 1200 baud rates are commonplace, 2400 baud and even 9600 baud rates are now commonly advertised in upscale modems where access to a mainframe is desirable.

Readers contemplating regular transmission of long files should consider the 1200 baud feature as a time and dollar economizer; a file of 10,000 words can be sent in six minutes at 1200 baud, but would require almost 25 minutes at 300 baud. Novice, irregular or informal users with more casual needs will find the 300 baud modem acceptable. Please note, however, that modems at each end of the line must be operating compatibly at equal speeds.

Modems are of two types, the older acoustic modem (easily identified by its rubber cups to cradle the telephone receiver), and the direct connect which is more reliable because it bypasses the telephone. (The latter requires modular plugs which older houses may not have, and are also more expensive). Further, modems are connected internally or externally. External modems sit outside the computer, connected via an RS232C port and a DB25 connector. Internal modems reside in one of the computer's expansion slots.

4.2.3 The Serial Interface Card

Efficient, effective data transfer requires the assistance of an additional service associated with the modem: a serial interface capacity. It should be

known that a computer sends its code around internally on a "bus" of eight, 16 or 32 individual "wires" (lines) depending on the capability of the microprocessor. One character of code consists of "ones" or "zeros" travelling parallel to each other across this "bus" of wires.

To send messages using this method of information transfer would require an equivalent amount of telephone wires, which is obviously impractical. Therefore, the computer requires a "serial interface" which converts the character codes that travel beside each other (parallel) to "single file" (serial), and codes can travel down a single wire (even though it slows their travels slightly). Serial interfaces may be integrated as part of the modem or may be on a separate card installed in the computer.

4.3 Information Utilities

Once the above hardware/software acquisitions have been made, the microcomputer user can access the global village. That village contains an ever-expanding array of information bases to tap which are commercially available at variable rates depending on subscription fees and connect time.

It is important for readers to note that these information services can all be reached independently should the user be prepared to incur the long distance telephone charges involved. Of special interest to those living in relatively-isolated areas, however, is the provision of inexpensive digital transmission through packet switched networks made available by telephone consortiums. For example, TELENET, TYMNET and UNINET in the United States and DATAPAC in Canada can be accessed through one of many "pads" (packet assembler-disassembler) which are usually located in a larger urban community.

Subscribers are therefore able to reduce expenses by unobtrusively sharing common digital telecommunications circuits which can carry a vast amount of information units concurrently. This acts to reduce substantially the costs involved, although users beyond the catch area of the primary pad numbers will incur a small connect charge to them.

Almost 350 "data repositories" accessible by a microcomputer and modem, containing over 2400 files, are presently in existence. (Lisanti, 1984). While commenting that present subscription rates vary from a \$35 subscription fee to thousands of dollars, one author (Lisanti, 1984) noted that on-line searches are

becoming progressively less expensive as major information utilities introduce low cost subscriptions to the most utilized bases.

Readers interested in acquiring constantly updated information on bulletin board systems in the U.S. can access either one of the following sources: Orrini On-Line Database Directory (Mae Millar Publishing, New York), or The Computer Phone Book (New American Library, New York).

Several of the more popular information utilities will now be described.

4.3.1 Dialog/BRS "After Dark"

Two of the largest information utilities (Johnson, 1984) of interest to those in the educational community generally are DIALOG's "Knowledge Index" (24 databases, at time of printing) and BRS (After Dark) which permits access to 36 databases (at time of printing). Some of the databases included are the following:

- ERIC (Educational Resources Information Center, Bethesda, MD)

ERIC has more than 1/2 million entries and includes approximately 32% research and technical supports, 20% conference papers,

11% project descriptions, and 11% guides. It is a rich resource for special education searches of numerous kinds.

- ETSF (Educational Testing Service Test Collection, Princeton, NJ)

ETSF describes more than 5,000 test materials and evaluation tools of all kinds.

- ECER (Exceptional Child Education Resources, Reston, VA)

ECER lists journal articles, curriculum materials, texts, program descriptions, conference papers, and dissertation citations of interest to any area of exceptionality.

- RICE (Resources in Computer Education, Portland, OR)

RICE collects information on all aspects of educational computer applications, including software evaluations.

- COMPUSERVE (CompuServe Information Service, Columbus, OH)

COMPUSERVE offers a wide collection of information through knowledge categories

such as financial, electronic encyclopedia, shopping, banking and text editing: MECC (Minnesota Educational Computing Consortium) software catalogs, as well as the last five year acquisitions of ERIC (noted earlier) can be accessed through COMPUSERVE.

- THE SOURCE (McLean, VA)

The source offers over 700 programs in an easily

accessed menu-driven format which includes news, business services, entertainment, travel, word processing, and the like.

Thus, most information utilities offer a broad catalogue of specialized data bases.

4.3.2 SpecialNet

Of special interest to the reader is SPECIALNET, which offers electronic mail, bulletin board, and data collection/information management services targeted specifically to those involved in all aspects of special education. At the time of printing, SpecialNet had almost 2,000 individual and agency subscribers, and while the great majority reside in the United States, this service is now attracting international attention. It is the largest computer-based communication network oriented toward educational concerns in the U.S.

Developed by NASDSE (The National Association of State Directors of Special Education), SPECIALNET had thirty-five boards or information bases at the time of printing. These include technology areas (eg. computer, software, television), program areas (eg. early childhood, deaf), special education management

(eg. litigation), and special purpose boards (eg. CHAIN - a parent oriented information base.) Eighteen boards are designed to appeal to a general audience, while the remaining seventeen have a focused objective.

SpecialNet offers numerous information access and communication potentials for those interested in special education, and further details regarding its potential can be obtained from its originator, Gary Snodgrass (2021 K Street, Washington 20006).

SpecialNet's format for designating competent individuals or agencies to act as board managers provides a model for small board management. To illustrate, the Centre for Special Education Technology (which is sponsored by the U.S. Department of Education but located at CEC headquarters in Reston) shares it's broad mandate through news releases, monographs and academic publications. It also manages two electronic bulletin boards on SpecialNet, Tech Line (a "closed" board), and Tech Talk (an "open" board) sharing both specialized and general knowledge on technological applications. Other individuals or agencies manage specific boards, for example Education Turnkey Systems in Virginia manages the "Computer" board, while the "Voced" board is managed by the University of Missouri. SpecialNet subscriptions cost \$200 (U.S.) per year and

the subscriber incurs a monthly connect-time charge in addition.

4.3.3 Other Data Bases Geared to the Handicapped

Of interest to the reader are the following selected special data bases focused on the concerns of the handicapped. A sample of these include:

- ALBEDATA (National Rehabilitation Information Center, Catholic University of America) which includes information on rehabilitation and technical aids;
- REHABDATA (also from Catholic University of America), which is an electronic source for information in computer applications for the handicapped;
- NIGSEM/NIMIS (National Information Center for Special Educational Materials, University of Southern California) which provides media and devices for use with handicapped children in the school system;
- NISH (NATIONAL INFORMATION SOURCES ON THE HANDICAPPED) (Clearinghouse on the Handicapped U.S. Department of Education) which lists all resources and organizations assisting handicapped persons;

- TRACE (Trace Center University of Wisconsin) which lists many of the available computer communication aids and rehabilitative aids on computers for the disabled;
- ERIC (Eric Clearinghouse, The Council of Exceptional Children) which distributes school based information on the handicapped. ERIC was described more fully at an earlier point.

4.4 University-Based Networks - The Example of "CONFER" and the University of Michigan's MERIT Network

At this point, brief mention is made of the University of Michigan's electronic conference system - MERIT - which is jointly supported by four major Michigan Universities: Michigan, Michigan State, Western Michigan, and Wayne State. It serves as an excellent example of a specific purpose system which has expanded to meet emerging needs.

Utilizing the CONFER Software package, users are able to access data on microcomputers generated by the Centre for Research on Learning and Teaching. Unlike SpecialNet, which at the time of writing required a \$200 annual subscription fee, systems such

as CONFER are free due to users, to the non-profit nature of the sponsoring institutions. Thus, potential conference board users would only have to acquire legitimate access and thereafter pay comparable telephone connect times.

Further information on CONFER can be obtained from the University of Michigan's Professional Development Office (610 E. University, Ann Arbor, Mi. 48109).

Such conference systems are expected to grow expotentially in the near future, and to expand to link specific campuses to the larger network of academic institutions. One example of this catalytic effect is provided by NETNORTH, which originated at the University of Guelph and soon expanded to six other Ontario universities and community colleges, McGill University in Quebec, and the National Research Council in Ottawa. In 1984, IBM provided the funding to permit NETNORTH to establish a three-year liaison with Cornell University and thereby access to an American-based university network identified as BITNET. At the time of printing, NETWORTH was being extended throughout Canada, and will soon permit a North America/Europe/Israel affiliation.

4.5 Corporate Sponsored Networks - The Example of Commodore Corporation's Educational Resource Centre

Unique telecommunications systems supported totally as a service to large scale purchasers of hardware designed by computer companies are in existence, perhaps the most extensive being Commodore's Educational Resource Centre (with over 500 participants at the time of writing).

Commodore provides participant schools and agencies with requisite facilitative devices (a VICMODEM telecommunications access device), a specialized conference/bulletin board facility (COMED, the special interest group on the COMPUSERVE Information Service), and free or nominal cost subscriptions to COMPUSERVE. They are thereby able to share information regarding innovative microcomputer user, resources, and technical assistance.

It is obvious that corporate support of telecommunications networks can be expected to expand in the future, and advocates for special needs populations should piggyback on these efforts developed to serve the broader educational community.

Details on the Commodore program can be obtained

through their education division: 1200 Wilson Drive,
West Chester, PA. 19380.

4.6 Advocacy-Originated Networks - The example of the
Disabled Children's Computer Group, San Francisco

This article has identified that microcomputer based telecommunications systems can benefit any who have made the requisite equipment purchases and who wish to advocate on behalf of special needs populations. One of the most exciting groups known directly by the author is the Disabled Children's Computer Group based at the Lawrence Hall of Science (University of California, Berkely 94720).

The Disabled Children's Computer Group was formed in November, 1983 by a group of parents of disabled children, and now include parents, teachers and professionals in the field of education, social services, and computer technology.

The DCCG provides a forum for the sharing of information and experiences about computer applications for all categories of disabled children. They have established a "lending library" of computer hardware for disabled children, providing parents an opportunity to try out a system before investing. They also operate a Demonstration Center, which serves as a focal

point for hardware modification and software development and for parent, teacher, and student training.

More recently, the DCCG has established a local computer network to share resources and needs, with an electronic bulletin board as part of this network.

Advocacy-originated electronic networks, such as that sponsored by the DCCG, can be expected to grow if motivated individuals are prepared to dedicate the human and technical resources such systems require.

4.7 Research-Oriented Networks - The Example of New York University's DEAFNET Project and the McGill University REFLEXIVE Communication Project

Both New York University and McGill University have originated research projects designed to facilitate learning by different special needs target groups.

Recently, the School of Education's Deafness Rehabilitation Program of New York University received a short-term grant from the National Institute of Handicapped Research to investigate innovative paedagogical strategies in the area of language arts/literacy skills for deaf young adults.

Of interest is the project's use of an interactive telecommunications system, made possible by GTE's donation of ten communications terminals and a DEAFNET subscription access. Thirty deaf students ranging in age from 16 to 21 years work at terminals that link five cooperating schools (in the Albany, Boston, New York City, Northampton, and Washington, D.C. areas). Electronically-conveyed concurrent messages are generated and modified by participants who improve their language arts facilities.

An interesting Canadian application of telecommunications is provided by an ongoing experiment with gifted children in Montreal entitled "reflexive communication" (Brennan & Spriggs, 1984). In an attempt to motivate gifted students to acquire computer-based skills and to share ideas, this project enabled them to develop joint science projects concurrently over distance as computers linked by modems share the same program. Using Radio Shack Duofone telephone amplifiers (which enable hands-free voice contact) to supplement the data exchange on the computer, these students actively edit and modify documents of their own design. Of special interest is the fact that the hardware system required is readily available - two computer stations, each with an Apple IIe (or II+compatible) computer, monitor, at least one

disk drive, and a modem. The software required is equally common and relatively inexpensive - a communications program permitting transfer of any DOS file (DFX-II) a word processor program (Bank Street Writer) and additional software permitting presentation of experimental data (Visicalc) and graphic data (Visiplot).

While this project is presently limited to gifted students, the process it identifies has a wide generic application to many special needs students.

Such research projects, where electronic communications systems facilitate the application and generalizability of research projects, should generate more vital information of benefit to all children unable to physically interact directly.

4.8 Service-Oriented Networks - The Example of the Prairie Post (A bulletin Board Developed by The Rural Special Education Outreach Project, University of Lethbridge, Alberta, Canada)

The Rural Special Education Outreach Project of the Faculty of Education of the University of Lethbridge (Alberta, Canada) was established in 1981. In that year earmarked time-specific funds were awarded from the Department of Advanced Education and Manpower (Government of Alberta) on the basis of a proposal

developed by the author. The first phase of the project terminated officially in March (1985), and a three-year extension has been negotiated in which an exemplary model for rural service delivery will be the primary outcome.

In its first phase, the RSEOP envisioned its primary responsibility as the upgrading of special needs service delivery through a two-pronged approach in a limited region of the province (Southwestern Alberta). Firstly, the delivery of effective but traditional inservice workshops was to be facilitated by bringing experts on-site for focused training. Secondly, the development of a pilot microcomputer lab was included, with a limited budget to collect and disseminate hardware and software samples thought to be exemplary. A small electronic bulletin board system, enabling a cost-effective alternate communication system for selected regional participants, became the primary interest of the lab. Board users eventually generated the label "Prairie Post" to identify their new system.

From November, 1984 to June, 1985 that support enabled the gradual absorption of 34 cost-free subscribers to the "Prairie Post" network. These 34 participants accumulated almost one thousand

interactions through 107 hours of time, with an average connect time of nine minutes. The great majority of these were accumulated in the first quarter of 1985, since 1984 was dedicated to start-up activities.

The Prairie Post had these primary objectives:

- to develop a physical network of hardware units in the region which would become the RSEOP Bulletin Board, and to establish a communications network between them;
- to share these units in a pilot phase of the project between selected representations of the teaching and administrative components of the School Systems within the rural region of southwestern Alberta;
- to "broker" information services available on information utilities (such as SpecialNet and BRS-After Dark) on behalf of the participants, and to establish appropriate subscription contracts with these utilities;
- to encourage the development of a variety of telecommunications applications through the RSEOP network, including electronic mail, internal and external consultation services, and electronic conferencing between system participants.

A number of hardware-software acquisitions formed the central unit of the RSEOP bulletin board system.

A bulletin board program developed by Micro-Data

Products (Aurora, CO) was purchased to run continuously on the Apple IIe master unit.

An Apple Super Serial Card acted as the modem interface, and a Hayes Smartmodem 1200 served as the modem, accepting calls at either 300 or 1200 baud rates on a dedicated line (403-329-2738).

The Board utilized two software packages to permit data-capturing capability. Transend enabled auto-dial interactions between bulletin board users and the network. Datacapture IIe provided software enabling message format and transmission.

A Percom hard disk system (10 megabyte winchester drive) enabled the board to incorporate storage that is the equivalent of 19 floppy disks (2000 pages of single-spaced documentation). To date, the full storage capacity has not been utilized .

Incoming and outgoing transactions were monitored by the Thunderware "Thunderclock" time card which collated and reported the frequency and duration of all calls. (This monitoring function is critical to all cost-sharing projects, which the Prairie Post will become in its second phase, commencing at the time of writing).

The RSEOP provided all equipment necessary in the pilot phase, and established external stations. Each had the following configuration: an Apple II series computer, double disk drive and terminal, printer, datacapturing program, wordprocessing program, and modem.

Seven special function boards were developed (Computer, Precision Teaching, Exchange, Inservice Conference, University, and Adaptive Devices), which reflected the interests of participants. The content and number of Boards will be modified substantially as the Project enters its second phase and the Prairie Post assumes a posture of service to the larger educational community.

At the time of writing (September, 1985), the Prairie Post was in transition from its former role of exclusive service in the rural special education community. The Four Worlds Development Project (native education) and the Gifted Education Project, both high profile recent projects of the Faculty of Education, will operate their own boards on the Prairie Post. Also, it will become the base for a local area network joining selected members of the Faculty of Education.

All future developments associated with the

Prairie Post can be obtained by writing the author or
SYSOP (Mr. Marlo Steed) (c/o Faculty of Education,
University of Lethbridge, Lethbridge, Alberta, Canada
T1K 3M4). Specific research questions of interest to
the telecommunications community will be addressed in a
limited number of future Prairie Post projects.

EPILOGUE - A DYSTOPIAN VIEW

THE ALTERED HUMAN LANDSCAPE

Problems Associated With Microcomputer
Telecommunicating

Defects are always more tolerable
than the change necessary
for their removal

- Descartes

A somewhat utopian vision of the practical and humanitarian aspects of communication via microcomputer has been presented thus far. It is of value at this point to consider some of the potential factors which might reduce this phenomenal potential.

Several dystopian phenomenon might emerge as segments of the population gain relatively unlimited access to knowledge.

We are presently at a major turning point in history, one in which individuals with complex combinations of special needs stand to gain much through the application of technology. It is to be recalled that such individuals have not received an equitable share of educational resources under traditional service structures. Being handicapped has

been synonymous with being disadvantaged, and reduced power and control in the human as well as physical environment. Will the knowledge explosion, now more equitably distributed to the handicapped, lead to greater independence and to greater latitude of choice in making important life decisions? Will the handicapped actually be empowered and politically emancipated through technology? What sociopolitical changes might accrue as a result of expanded access to information by this subgroup?

Wolfensberger has argued that both physical and mental abuse have long accompanied the lives of the handicapped, many of whom are devalued and seen as deviant in the dominant culture. He suggests that a handicapped individual is stigmatized because he/she is "perceived as being significantly different from others in some aspect that is considered of relative importance ... (and) negatively valued." (1972, p.13)

Many of his writings identify the specific limitations imposed on the lives of the handicapped as a result of denigration. Wolfensberger also suggests that some individuals and groups benefit, directly or indirectly, from keeping handicapped individuals in positions of dependency. If this premise is correct, what new social inventions in the global village will

develop to extend such control over the lives of others into the future?

Those who advocate for technological extensions to the handicapped population must be prepared to argue vehemently for equity of access:

With all of this exciting technological progress, however, new problems are being created. Now that functional technical aids are available, we must address the task of getting them to the people for whom they have been created. The first aspect of this is that of awareness building. People who need, or who have clients who need, technical aids must become familiar with the capabilities that these systems offer. At the next level, those rehabilitation professionals who select and apply technical aid systems must learn how to do so in a manner that best serves the interests of the client. Finally, funding for technical aids and the necessary corresponding services must become more straightforward. In all of these areas we are making progress, but more work is needed. (Romich & Vagnini, 1984, p. 77).

Technology proponents must remember that technology is not seen as a panacea in many circles generally. Amongst some, it is viewed with fear to the point that the term "technophobia" is applied to describe the reaction. Advocates for special needs individuals know well the cycle of rejection which many face, and arming such individuals with technological hardware may act to create even further social distance from those who feel alienated from both.

This potential malaise may be even more acute in the domain of public education, where innovation in both attitudes and methodology is not commonplace. Lindsley (1984) has identified that many powerful technologies were resisted by the educational community until the eleventh hour. These included moving pictures (1911), the typewriter (1920), overhead projector (1944), television (1962), programmed instruction (1955-68), and microcomputers (1977). Even today, the mass presence of microcomputers in schools is not a guarantee of their appropriate utilization or equitable distribution to children.

It is widely accepted that the educational community prefers to make haste slowly. For example, a study commissioned by the National Science Foundation in 1973 reported a time lag of two decades between discovery and implementation of ten major technical inventions (Selback & Hargen, 1984).

The dominant response to novel approaches in public education has been to directly resist their implementation, or more effectively to assign them to the eternal limbo of careful study, as the following recommends:

For schools to fully determine the applicability of microcomputers to the educational problems of special needs children, a planned change approach to

microcomputer implementation must be taken. A critical element of this planned change approach involves the assessment of a range of organizational factors which may be predictive of the effectiveness of a special services microcomputer program. (Sellenbach & Hargen, 1984, p.92).

These authors then provide an evaluation plan that includes an analysis strategy of eight educational organization factors - ability, values, information, circumstances, timing, obligation, resistance, and yield - each of which must be identified and encountered.

It is hard to argue with the wisdom of such an approach, and in the author's view, Sellback and Hargen's plan deserves special scrutiny. At the same time, waiting a decade or two to apply and enhance present technology that today can enrich the communication options of the handicapped is to deny the population a multitude of life-supporting experiences. Catholic theologians would call this a "sin of commission" because society thus denies opportunity for personal growth.

Microcomputers have already demonstrated their ability to support improved initial learning and transfer of knowledge organized and delivered by competent teachers. Microcomputer-based telecommunications can widely expand that potential if

we are prepared to examine a new set of human relationships occasioned by significantly altered modes of communication:

It would be a very serious error to look only at the technical aspects ... It is only in the context of a supportive educational community - a human environment conducive to learning - that the hazards ... can be avoided.

We must take it as our goal to draw people into an intimate and creative human context. The people who are on the receiving end of the innovations have to be involved in the transition. (Chorover, 1984, p.226).

These issues, brought to the surface by technological innovation, must be addressed by the educational community at large, if a significant redesign of human potential is sought.

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APPENDIX

Glossary Terms

Access: Used either as a noun or verb to indicate either gaining control of a system or the acquisition of data from a storage device or peripheral unit.

Acoustic Coupler: A data communications device that converts computer data into audible tones for communication over telephone lines. (The part of the modem that transmits data to the handset of a common telephone, but not the modem itself. The telephone handset fits into special rubber cups for transmissions of data.)

Adaptive Firmware Card: A plug in card for the Apple, produced by Adaptive Peripherals, that allows a disabled user to bypass the keyboard and enter information on the computer with a variety of single and multiple switches, scanning techniques, Morse Code, and others.

Alphanumeric: Data that consist of letters and numbers.

Artificial intelligence: An area of study aimed at developing machines that "think" like humans. Pretty much a buzzword.

ASCII: An acronym for American Standard Code for Information Interchange. It is an international standard that defines how characters are represented in a computer's storage.

Asynchronous: Participants in a computer network do not need to be present at the same time to interact. The store and forward features of the computer permit users to access information and messages at their convenience.

Basic: Beginner's All-purpose Symbolic Instruction Code. A programming language designed for easy use.

Baud: A measurement of communications speed between devices. Baud can be roughly translated into characters by dividing by 10: 1,200 baud is 120 characters a second.

Bit: A contraction of binary digit (1 or 0). A bit is the smallest unit of information in a digital computer.

Bootling (or bootstrapping): A term for loading a program - usually the operating system - into a computer.

Buffer: A temporary storage area for holding computer data until they are processed by another device. It is needed because the data can flow at different rates between a computer and its peripherals.

Bug (debug): A problem or mistake, usually in the software. Debugging is the process of correcting it. The term dates from the days of primitive computers, when the vacuum tubes attracted insects that caused short circuits.

Bulletin boards: Systems on computer networks where computer users can deposit and read messages.

Bus: A set of electrical circuits into which other circuit boards can be plugged.

Byte: A unit of computer memory, made up of a series of bits. One byte will store one number, letter, character or space. Bytes are normally measured in groups of 1,024 which are designed by a "K". The "K" (bytes) a computer has, the more memory it has.

CAI (Computer assisted instruction): Instructional materials and tutorial programs presented via a computer. The application usually involves a dialogue between the student and a computer program which informs him-her of mistakes as they are made.

Carrier services: Communication services available on the networks of authorized common carriers (that is, telephone company network services).

CBMS: Computer-based message system.

Coaxial cable: An insulated, central conducting wire wrapped in another cylindrical conducted wire and enclosed in a protective cable. Coax can carry large amounts of information and is used to hook computer terminals together.

Compatibility: The ability of two devices to work together. In addition, if a program can be run successfully without alteration on two different computers, then the computers are generally said to be compatible.

Courseware: Software written for educational purposes.

CP/M: Control program for microprocessors. A disc operating system for micros developed by Digital Research Inc.

CPU: Central processing unit. The part of the computer containing the circuits that interpret and execute instructions.

Crash: What happens when a computer becomes inoperable because of a hardware malfunction or software error.

Cross talk: In telecommunications, the unwanted transfer of energy from one circuit to another.

Cursor: An indicator on a video display screen that shows where the next character will be typed.

Daisywheel printer: A printer where the type head is circular, with the characters attached to it on the ends of stalks. It prints fully formed characters and is usually used with word processing systems.

Data base: A store of interrelated data on files, for use in an information retrieval system.

Data communications: The transfer or exchange of information between computers, requiring the transmission of digital signals.

Disc (disc drive): A disc is a circular plate coated with magnetic material on both sides to store information. For data retrieval, it is rotated inside a disc drive. It can be floppy (flexible) or hard.

Disc operating system (DOS): A computer program responsible for the housekeeping and communications functions needed to get the disc storage system and main computing unit to work together. DOS also handles communications with other peripheral devices.

Diskette: Normally refers to a 5 1/4-inch floppy disc.

Download: To transfer data or programs from a remote location into a computer. Sending to the remote location is called uploading.

Dumb terminal: A terminal with no independent processing capability of its own. It only works when connected to a computer. A smart terminal, by contrast, has some data processing capability. An intelligent terminal can be used for local processing without connection to a central unit.

Duplex (full duplex): The ability of two devices to transmit simultaneously and separately along the same communications channel. Half-duplex designates the ability of devices to transmit in both directions, but not at the same time.

Electronic mail: A general term for the electronic distribution of messages that can be stored for reception or reading at a later time.

Emulator: The act of imitating or performing as if a device or program were something else. An emulation program permits a computer to imitate another brand or type.

End user: The user who ultimately receives computer service or information.

Expert system: A development of artificial intelligence. The effort to have a computer contain specialized knowledge and mimic the thinking of a human expert.

External memory: A device or series of devices capable of storing information that expands a computer's internal, or main, memory.

Fibre optics: The use of glass fibres of very small diameter to transmit information via light waves.

File: A collection of similar data, or a group of related records, treated as a unit.

Floppy disc: A disc made of flexible magnetic material, housed in a cardboard envelope. It usually refers to an eight-inch-diameter disc. There are minifloppy (5 1/4 inches) and microfloppy (three to four inches) discs.

Gateway: A point in a communication network that has a high density of use and equipment and that provides a link between two or more networks. Telephone companies also provide gateway services so that users can access different data bases with one access code and terminal.

Hard copy: Text and graphics printed out on paper.

Hard disc: A disc made of rigid, ceramic-like material with a magnetic coating. It stores much more than a floppy disc; an eight-inch hard disc for personal computers can store up to 100 million characters. There are 12-inch and 14-inch discs for larger computers.

Hardware: The physical components of a computer system.

Informatics: The collection of technologies involved in handling information by computer.

Information centre: A large computer that serves data processing needs, as well as the main memory and controller of decentralized terminals and smaller computers in a network.

Information provider: An individual or organization that provides information for a data base.

Integrated software: A collection of computer programs that are interactive. For example, data can be transferred from one to be used in another.

Interconnect: Organizations other than regulated telephone utilities that supply telephone terminal equipment. The term also refers to the regulatory decision permitting customer ownership of telephones.

Interactive: The use of a computer, or other device, in such a way that the operator (computer user) is in control of its activity. An interactive system may also be conversational, implying continuous dialogue between the user and the system.

Light pen: A hand-held light source that is connected to a cathode ray tube. When it is pointed at the tube, the position of the light spot is sensed and images can be created, moved or deleted.

Local area network (LAN): A communications system that allows several information processing devices to link with one another for a limited distance, such as within a college campus.

Main memory: The computer's internal memory, also known as RAM or core memory. It is volatile, which means the contents will be destroyed if power is lost.

Mainframe: Any large computer.

Menu: A list displayed on a terminal describing functions a user can choose.

Microcomputer: A desktop computer that uses a single chip, the microprocessor, as the central processing unit.

Minicomputer: A computer of intermediate size and computing power between a mainframe and a microcomputer.

Modem: A contraction of modulator-demodulator, a device that translates computer data into pulses that can be transmitted over telephone lines or optical cables.

Multi-tasking: The computer's ability to do more than one job or program at the same time.

Network: A system consisting of a computer and its connected terminals and devices. Computers can also "network" with each other.

Noise: The unwanted electronic signals in telecommunications.

On line: Refers to equipment that can interact directly with a computer's central processor.

On-Line Services: Usually a term to describe a company that provides information searching services for a fee, available over telephone lines to a computer.

Operating system: The set of programs that make it easier to operate the computer. It acts as a kind of traffic cop, directing tasks such as input and output between the computer and its peripherals, or accepting and interpreting information entered through a keyboard.

Optical fibre: A very thin, flexible fibre of pure glass that transmits pulses of light from a laser or light emitting diode. It can carry much more information than copper wire.

PABX (PBX): A private automatic branch exchange is a switching system within a company that also has access to the public telephone network. If it is operated manually, it is a PBX.

Packet switching: A method of data communications in which the message is split up into smaller units, transmitted and reassembled at the other end. Each packet may be sent by a different route.

Peripheral device: A device that attaches to the computer, such as a disc drive, terminal or printer.

Protocol: A format of communications for information exchange.

RAM: An acronym for random access memory, also known as internal memory. It is memory that can be altered by writing over previous contents. RAM is volatile and the contents will be destroyed if power is lost.

ROM: An acronym for read-only memory. ROM is a form of internal memory or chip on which the commonly used programs are permanently placed to be ready by the computer.

RS-232: An interface standard for asynchronous data communications between any two devices.

Software: The collections of instructions or programs that direct a computer's operations.

Stand-alone: A device that is self-contained, not dependent on another unit for memory or processing.

Supercomputer: A very fast, high capacity mainframe used for highly complex, rapid calculations such as those for weather forecasting or oil reservoir modelling.

Supermicrocomputer: A high-end microcomputer, usually with a 32-bit microprocessor, that has power comparable to that of the larger minicomputers.

Teleconferencing: A general term for conferencing that involves telecommunications links. It includes: full-frame videoconferencing, where people can see and hear participants at other locations; audio teleconferencing; slow scan and freeze-frame image transmission.

Teletext: A one-way, non-interactive system that transmits information through regular or cable TV broadcast signals or through FM radio signals to an adapted TV set.

User-friendly: An overused buzzword, referring to a system that relatively untrained users can operate easily. It should be replaced by "easy to use".

Videotex: A two-way information system that uses television sets or special terminals. Information is displayed with text and graphics.

Winchester disc: A very common type of hard disc. Supposedly so named because International Business Machines Corp., which developed the technology, used the product code 3030, recalling the Winchester rifle.

Windows: Software that allows the user to see several functions at once on a single screen - the screen is partitioned.

Word processor: A computerized system or program used for writing.

X.25: The international standard for packet switched data networks. The protocol was developed by Bell Canada and approved in 1982 by members of the international telecommunications standards body.